Automatic Line Network Extraction from Aerial Imagery of Urban Areas through Knowledge-Based Image Analysis

Fifth Interim Report
September 30, 1988

United States Army
European Research Office of the U.S. Army
London
England

DTIC
ELECTE
NOV 1 4 1988
E

88 11 10 028

Present Status

During the last months work has been concentrated on two topics, namely (1) production of segmentation results at the symbolic image analysis level from improved low-level and medium-level processing, and (2) integration of these segmentation algorithms into the blackboard-oriented (BPI) environment.

1. Results of Image Segmentation

As we have pointed out in our last report, image segmentation is done by two competing methods: an edge-oriented one, and an area-oriented one. Application of both methods results in three different types of image segments: edges, obtained by the edge-oriented method, and bright resp. dark contrasting segments obtained by the area-oriented method.

Figure 1 to 3 show some results we have obtained by applying both segmentation methods to an aerial image of an urban scene. Figure 1 shows the edges, obtained after applying the edge-oriented segmentation procedure. It is easily to see, that most of the edges describe the original picture very well, nevertheless a minor portion of the edges are confusing and make an unambiguous extraction of the traffic network difficult.

Figure 2 to 3 show two selected results obtained by applying the area-oriented method to one aerial image. Remember the area-oriented segmentation method described in our last report. We select all dark/bright spots in level n of the spot-pyramid, exceeding given thresholds for strength and surroundedness. Then we project the selected spots from level n of the spot-pyramid to the level of best resolution of the gray-level pyramid and binarize the gray-level image in an appropriate chosen neighborhood of the enlarged spots.

Again it is easily to see, that the obtained segmentation results of each level are incomplete, and ambiguous; however the segmentation results of each level combined with the results of the edge-oriented segmentation will cause a significant improvement of image segmentation. This proceeding can be seen like putting together the pieces of a complicated puzzle.

2. Integration of Low-Level and Medium-Level Methods into the BPI-Environment

Our further aim, as described in our last interim report, was to integrate our image segmentation results into the blackboard-oriented production system for image understanding (BPI) implemented at FIM.

To avoid loss of information about the generated image segments, all calculated features of the segments are stored in the blackboard. The edge-like segments are described by their radiometric and geometric features, e. g. confidence, contrast, type or length, and by their corresponding edge parts, obtained by polygon approximation. The area-like segments are described also by their radiometric and geometric features, and by their contour parts.

Figure 4 shows an example of the edge-oriented method. After the segmentation of an aerial image the edge parts are stored in the data base and then plotted (thin lines). These short-lines are the terminals to build-up more complex objects. In this case we generated from the terminals long-lines, plotted in figure 4 as thick lines. These lines could be interpreted as the borders of the traffic network in the urban area.

Continuation of Work

The final phase of the contracted work is dedicated to the exploratory of the traffic network extraction of urban areas.
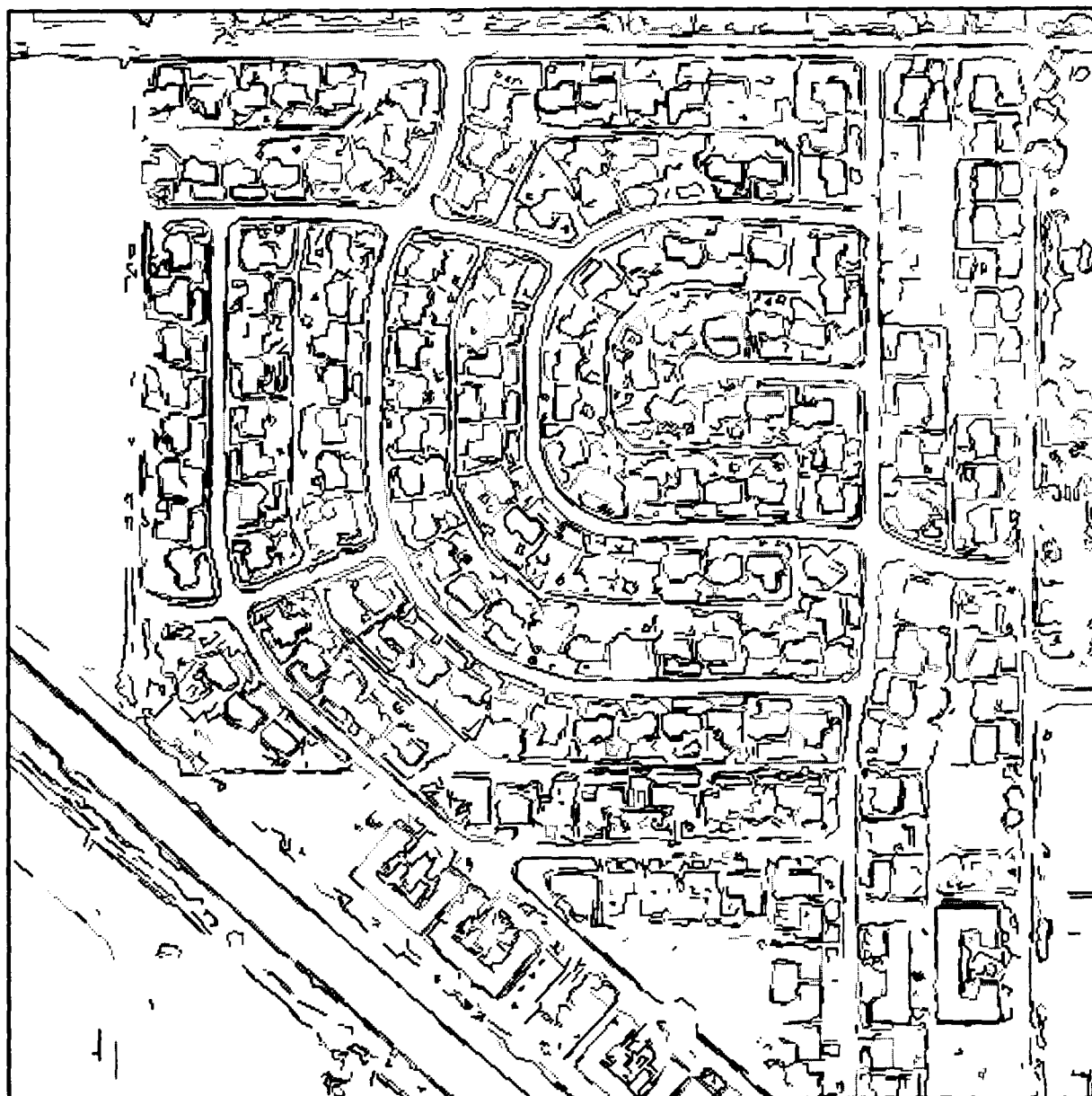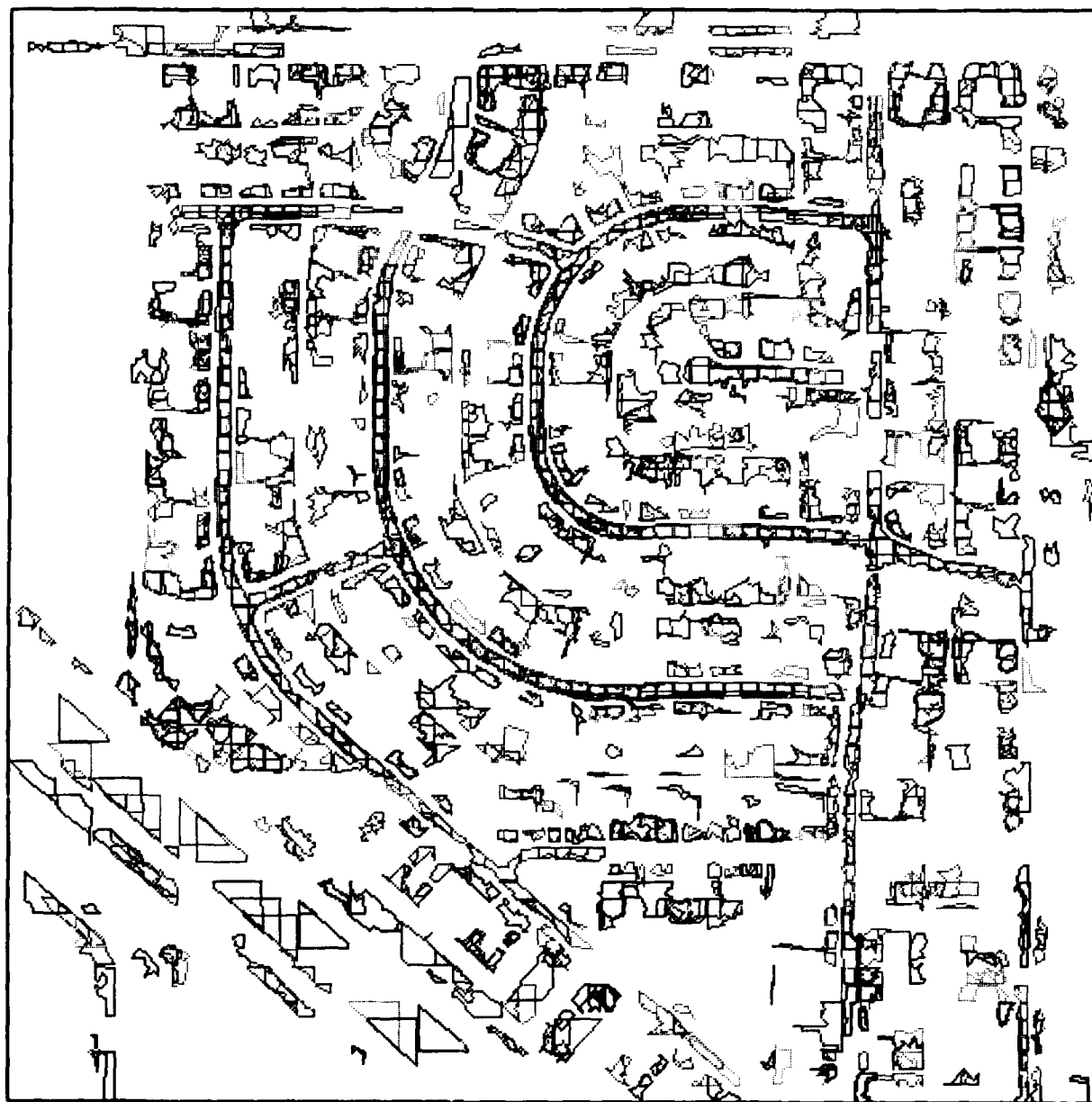
2

Figure 1: Edge segments

Figure 2: Dark contrasting areas, projected from level 6 to 9
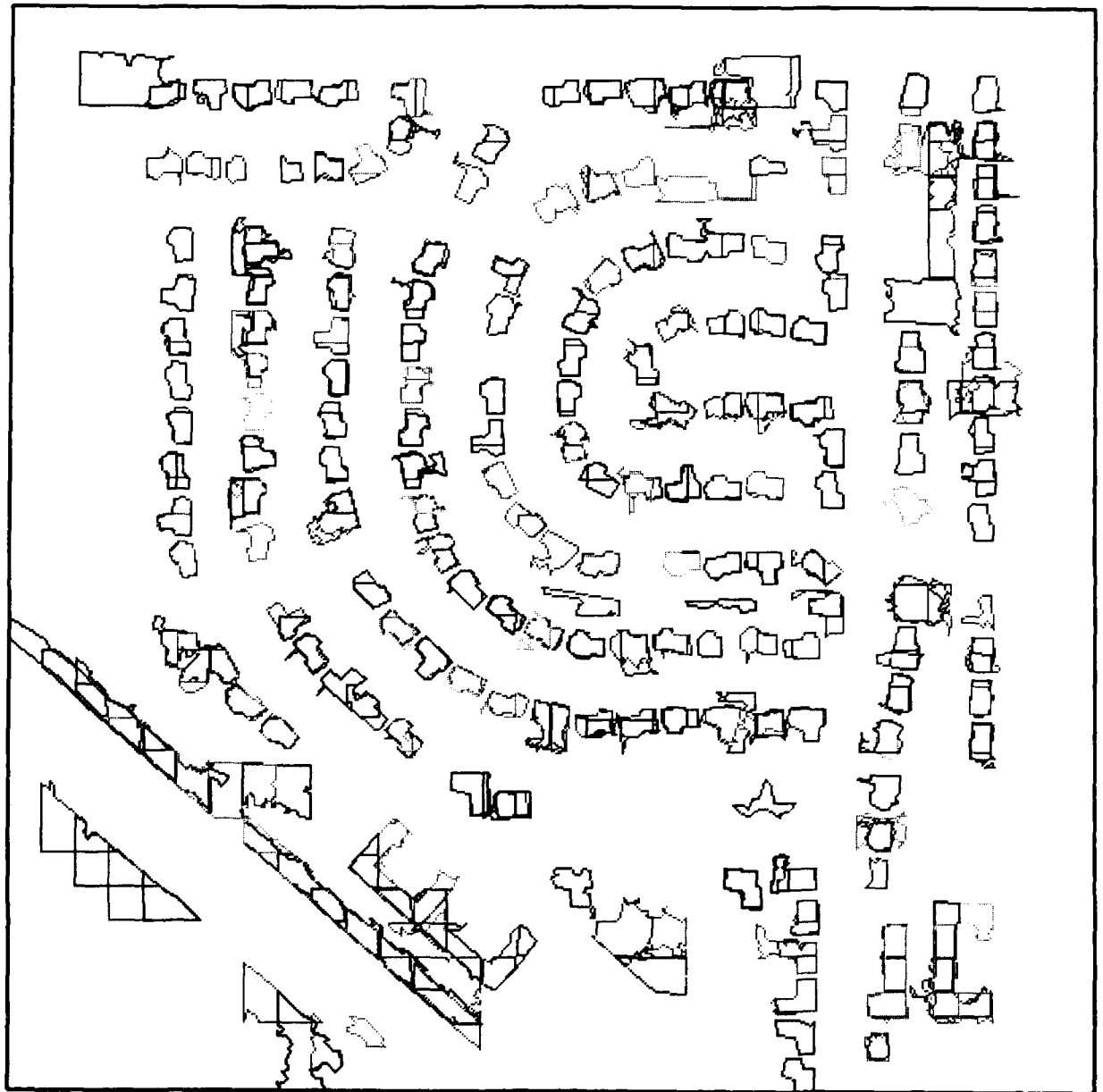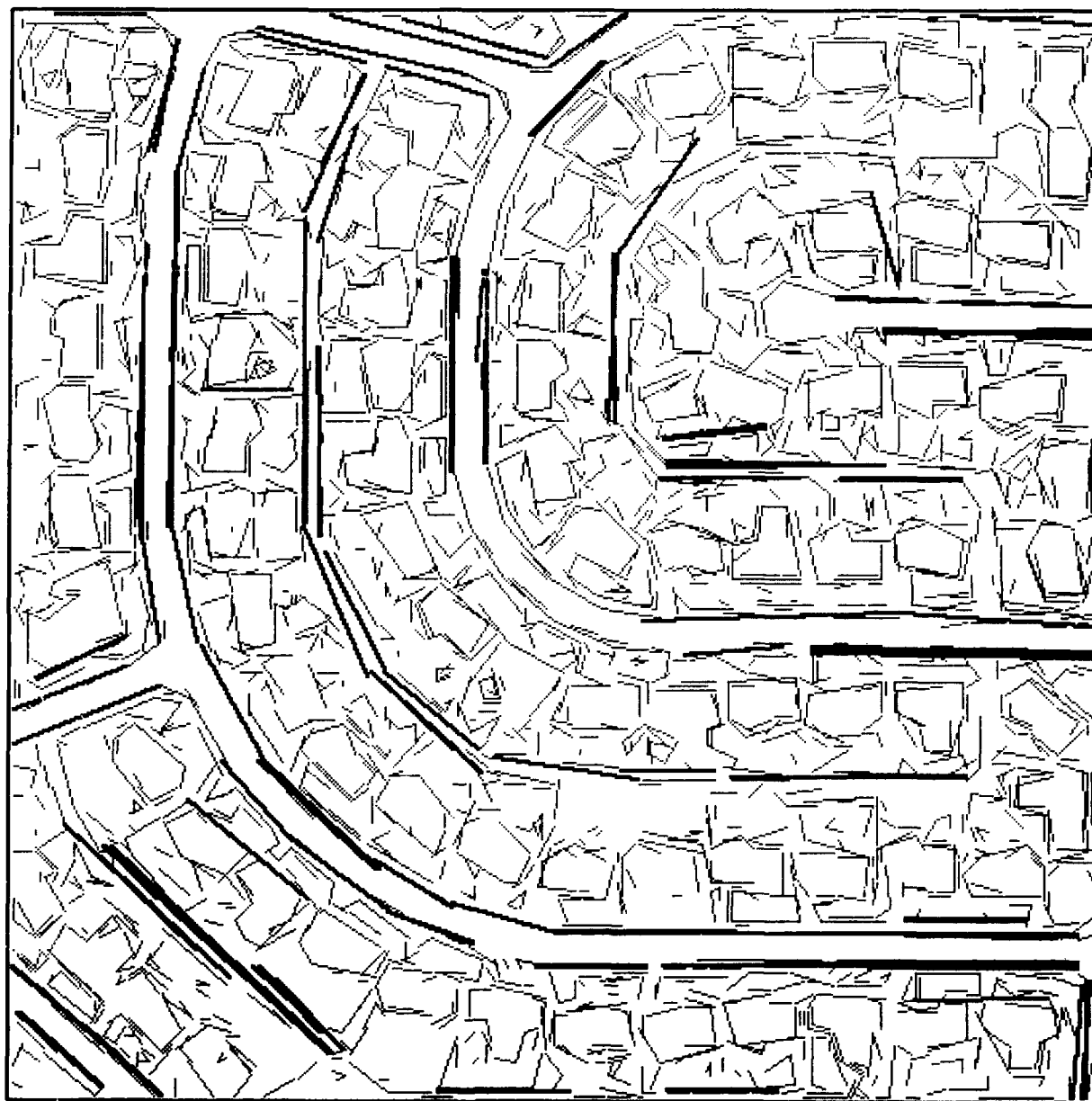
Figure 3: Bright contrasting areas, projected from level 5 to 9

Figure 4: Short-lines (thin) and long-lines (thick)